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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/605,442	06/28/2000	Leon R. Barstad	50439-2	5430
21874	7590	08/15/2006	EXAMINER	
EDWARDS & ANGELL, LLP P.O. BOX 55874 BOSTON, MA 02205			WILKINS III, HARRY D	
			ART UNIT	PAPER NUMBER
			1742	
DATE MAILED: 08/15/2006				

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

**Application No.**

09/605,442

**Applicant(s)**

BARSTAD ET AL.

**Examiner**

Harry D. Wilkins, III

**Art Unit**

1742

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 03 July 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 124-132, 134-137, 141-154 and 158-167 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 124-132, 134-137, 141-154 and 158-167 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 June 2000 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date: \_\_\_\_\_.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: \_\_\_\_\_.

## DETAILED ACTION

### *Status*

1. The rejections under 35 USC 112, 1<sup>st</sup> and 2<sup>nd</sup> paragraphs have been withdrawn in view of Applicant's amendments to the rejected claims.
2. The objection to the specification has been withdrawn in view of Applicant's clarifying amendments.

### *Claim Rejections - 35 USC § 103*

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 124-132, 134-137, 141-154 and 158-167 are rejected under 35 U.S.C. 103(a) as being unpatentable over Beach et al (US 4,334,966) in view of Bernards et al (US 5,051,154) and further in view of Dubin et al (US 5,972,192).

Beach et al teach (see abstract) a method of electroplating copper that includes electrolytically depositing copper from an electroplating bath containing copper sulfate, water, a suppressor agent (polyether) and 1-100 mg/L of a sulfonated, sulfurized benzene compound that behaves as a brightener (see col. 2, lines 41-46). The example given (see example 1) is benzene sulfate disulfide, which possesses a molecular weight of less than 1000.

Thus, Beach et al fails to teach (1) that the brightener included bis-sulfonopropyl disulfide and (2) plating on a semiconductor wafer substrate.

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Bernards et al teach (see col. 6, lines 29-37) using a bis-sulfonopropyl disulfide as a brightener at an amount up to 3.0 ppm by weight of solution (which converts to 3.0 mg/L).

Therefore, it would have been obvious to one of ordinary skill in the art to have used the bis-sulfonopropyl disulfide compound of Bernards et al as the brightener of Dahms et al because the bis-sulfonopropyl disulfide is a conventional brightener in copper electroplating that improves throwing power (see col. 5, line 49 to col. 6, line 13, esp. col. 6, lines 5-10) of the electroplating, thus making plating in vias and trenches more even.

Dubin et al teach (see col. 1, lines 5-40) electroplating copper onto a dielectric silicon layer of a microchip wafer with microvias and trenches.

Therefore, it would have been obvious to one of ordinary skill in the art to have applied the copper electroplating method of Beach et al to the silicon microchip wafer with microvias and trenches of Dubin et al because the method of Beach et al has good copper electroplating characteristics.

Regarding claims 135 and 152, Beach et al teach (see col. 2, lines 47-48) including 20-80 ppm chloride ion.

Regarding claims 136 and 153, while Beach et al and Dubin et al do not expressly teach electrically attaching the silicon wafer to the cathode, due to the underlying electrochemical reaction, the wafer is inherently connected to the cathode. This is also shown to be well known in the art by other art of record.

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Regarding claims 137, 154 and 160, Bernards et al teach using bis-sulfonopropyl disulfide ( $\text{NaO}_3\text{S}(\text{CH}_2)_3\text{S}-\text{S}(\text{CH}_2)_3\text{SO}_3\text{Na}$ ).

5. Claims 124-132, 134-137, 141-154 and 158-167 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dahms et al (US 3,778,357) in view of Dubin et al (US 5,972,192) and further in view of Bernards et al (US 5,068,013).

Dahms et al teach the invention substantially as claimed. Dahms et al teach (see abstract, col. 3. lines 44-55 and col. 4, lines 5-45) a method of electroplating copper onto a substrate including a soluble salt of copper (copper sulfate), a source of chloride ions and a brightener, such as sodium 3-mercaptopropane-1-sulfonate ( $\text{HS}(\text{CH}_2)_3\text{SO}_3\text{Na}$ ), at 0.0005 to 0.2 g/L = 0.5-200 mg/L. Thus, Dahms et al teach adding the brightening agent at up to 200 mg/L.

However, Dahms et al do not teach using (1) plating on a semiconductor wafer substrate, (2) a suppressor agent, such as a polyether, in the electroplating solution or (3) a sulfonopropyl disulfide compound as the brightener.

Dubin et al teach (see col. 1, lines 5-40) electroplating copper onto a dielectric silicon layer of a microchip wafer with microvias and trenches.

Therefore, it would have been obvious to one of ordinary skill in the art to have applied the copper electroplating method of Beach et al to the silicon microchip wafer with microvias and trenches of Dubin et al because the method of Beach et al has good copper electroplating characteristics.

Bernards et al teach (see paragraph spanning cols. 2 and 3 and col. 4, lines 31-45) adding a polyether surfactant to a copper plating solution to improve the throwing

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power of the solution (i.e.-improved even plating in high aspect ratio through holes (see discussion at col. 1, line 29 to col. 2, line 35).

Therefore, it would have been obvious to one of ordinary skill in the art to have added the polyether surfactant as a suppressor agent to the prior art copper plating solutions because Bernards et al teach that the polyether surfactant has the ability to improve even plating in high aspect ratio features.

Bernards et al teach (see col. 6, lines 29-37) using a bis-sulfonopropyl disulfide as a brightener at an amount up to 3.0 ppm by weight of solution (which converts to 3.0 mg/L).

Therefore, it would have been obvious to one of ordinary skill in the art to have used the bissulfopropyl disulfide compound of Bernards et al as the brightener of Dahms et al because the bissulfopropyl disulfide is a conventional brightener in copper electroplating that improves throwing power (see col. 5, line 49 to col. 6, line 13, esp. col. 6, lines 5-10) of the electroplating, thus making plating in vias and trenches more even.

Regarding claims 137, 154 and 160, Bernards et al teach using sodium bis-sulfonopropyl disulfide ( $\text{NaO}_3\text{S}(\text{CH}_2)_3\text{S}-\text{S}(\text{CH}_2)_3\text{SO}_3\text{Na}$ ).

Regarding claims 141 and 158, the sodium bis-sulfonopropyl disulfide ( $\text{NaO}_3\text{S}(\text{CH}_2)_3\text{S}-\text{S}(\text{CH}_2)_3\text{SO}_3\text{Na}$ ) has a molecular weight of 354.

Regarding claims 135 and 152, Dahms et al teach (see col. 4, lines 54-56) adding a source of chloride ions.

Regarding claims 136 and 153, Dahms et al teach (see Example 2) using the substrate as the cathode (i.e.-electrically connected to the cathode).

***Response to Arguments***

6. Applicant's arguments filed 3 July 2006 have been fully considered but they are not persuasive. Applicant has argued that:

- a. A skilled artisan would not have had any incentive to combine an electroplating solution for gravure rolls with an electroplating solution for electronics.

In response, one of ordinary skill in the art was well aware that copper electroplating solutions existed for various different purposes. However, it should also be noted that one of ordinary skill in the art was well aware that the basic copper sulfate-sulfuric acid electrolyte was suitable for many copper electroplating purposes, including gravure electroplating, printed circuit board electroplating, microelectronic device electroplating. Such statement is supported by the various references of record. One of ordinary skill in the art would have expected an additive, e.g.-a brightener, to the copper sulfate-sulfuric acid electrolyte for one purpose, e.g.-printed circuit boards, to have had the same effects, e.g.-throwing power, for other purposes, e.g.-gravure electroplating or microelectronic device electroplating. Thus, one of ordinary skill in the art of copper electroplating would have had a reasonable expectation of successfully using the additives of the different references for the known purposes.

- b. The comparison data provided in the specification is sufficient to overcome any *prima facie* case of obviousness supported by the references.

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In response, the Examiner disagrees. The prior art teaches utilizing brighteners at the claimed concentration ranges. The prior art also includes a single reference, Bernards et al, which discloses using the claimed brighter, bis-sulfonopropyl disulfide within the claimed concentration range. Thus, there is no unexpected result since the prior art clearly teaches using the claimed brightener concentration ranges.

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

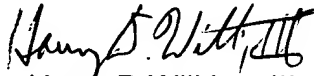
A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Harry D. Wilkins, III whose telephone number is 571-272-1251. The examiner can normally be reached on M-F 8:30am-5:00pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy V. King can be reached on 571-272-1244. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

  
Harry D Wilkins, III  
Primary Examiner  
Art Unit 1742

hdw